## REMARKS

Favorable reconsideration of this application is requested in view of the foregoing amendments and the following remarks. Claims 1-11, 15 and 25-34 are pending in the application. Claims 12-14, 16-24 and 27 are canceled without prejudice or disclaimer.

The claims are amended in order to more clearly define the invention, support for which is found in the figures and related parts of the specification. Specifically, support for the recitation of a bit rate rather than a chip rate in claims 1, 9, 15, 25, 32 and 34 is found at the last line of page 7 of the specification as originally filed and in claim 28 as originally filed. Referring to the last line of page 7, the phrase "bit rate" is generic with regard to symbol rate as evidenced by the parenthetical recitation of "(symbol rate)" between the terms "bit" and "rate." The preambles of claims 1, 32 and 34 are slightly broader by deletion of a phrase and, therefore, these claims are not narrowed by the amendments to their preambles. Claims 15 and 28 are rewritten in independent form and, therefore, these claims are not narrowed by the amendments that reformat them in independent form. The change to claim 8 make this claim broader and, therefore, the change to claim 8 is not a narrowing amendment.

At pages 2-3 of the Action, the Examiner discusses a restriction requirement. Applicant affirms the election of Group I, claims 1-15 and 25-34, with traverse. Claims 16-24 were withdrawn from consideration in the Action. The traversal is based on the fact that examination of all the claims would not be a burden on the Office despite their possible disparate classification(s). Nevertheless, as noted above, claims 16-24 have been cancelled without prejudice or disclaimer to expedite the prosecution of this application.

Applicant is investigating inventorship to determine whether the inventorship should be changed in light of the cancelled claims. A timely Petition to change inventorship will be filed if such a change is determined to be necessary.

Claim 9 stands rejected under 35 USC 112(1) as nonenabled. Claim 9 is amended to recite "further comprising" before the receiving limitations. Further, the preamble of base claim 1 is amended to not specify signal transmission.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 12-15 were rejected under 35 USC 112(2) as indefinite. Claims 12-14 are canceled without prejudice or disclaimer. Claim 15 is rewritten in independent form.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1, 7, 10, 27-28 and 32-34 stand rejected under 35 USC 102(b) as anticipated by Jung-yeol Oh et al. ("The bandwidth efficiency increasing method of multi-carrier CDMA and its performance evaluation in comparison with DS-CDMA with rake receiver", Vehicular Technology Conference, May 16-20, 1999, Pg. 561-565) (hereinafter Oh).

Before discussing in detail the deficiencies of the Oh reference, a brief review of the presently claimed invention is believed to be in order. The presently claimed invention concerns the achievement of higher channel capacity in a hybrid spread-spectrum system [i.e., one employing both direct-sequence (DS) and frequency-hopping (FH) or time-hopping (TH) modulation techniques through the use of ***highly*** overlapping direct-sequence spread-spectrum (DSSS) signals which are mutually orthogonal (i.e., mathematically separable). The orthogonality between given DS/FH signal pairs is established by operating the DS signals at a sequence of orthogonally-spaced hopping carrier (center) frequencies, which are in turn defined by the bit-wise detection [integration] interval, as defined on pages 7-9 of the specification as originally filed. More specifically, in the case of bit detection techniques in the receiver involving ***integration of the DS-chipped hybrid (i.e., DS/FH, DS/TH, or DS/FH/TH waveform over a full bit interval*** [and NOT over the DS-chip interval, as is the usual mode of detection], then the mutual orthogonality of the respective DS/FH signal pairs is maintained for the full bit time. In the presently claimed invention, the respective DS signals may in general be spaced by as little as

the bit-frequency (or half the bit-frequency for the phase-synchronous case). An additional clarification is that in the presently claimed invention there is no need for OFDM or simultaneous multicarrier applications; thus OFDM or MC techniques are not the subject of the presently claimed invention and are thus not relevant to the presently claimed invention's patentability.

In contrast, conventional existing-art systems achieve channel frequency separations of the ***DS chipping rate*** [the DS PN code length times the bit rate] for asynchronous (i.e., randomly phased) systems or ½ the chipping rate for synchronous (co-phased) systems [as described at page 8, line 15 to page 9, line 9 of this application as originally filed]. Also, conventional existing-art systems utilize OFDM or simultaneous multicarrier applications.

Oh discloses a methodology for increasing the bandwidth efficiency of a multicarrier CDMA (MC-CDMA) system [produced by performing the inverse fast Fourier Transform (IFFT) of the carrier frequency set]. This is accomplished by transmitting only half the baseband data signals and then reconstructing the entire baseband signals in the MC-CDMA receiver by exploiting the fundamental symmetry property of the complex IFFT operation (i.e., even function symmetric in its real part and odd function symmetric in its imaginary part). Since only half the baseband data symbols are transmitted, greater bandwidth efficiency is obtained (Oh, p. 561, Section I, 2nd column).

However, the Oh reference does NOT describe or teach the use of DS-CDMA or DS/FH systems, but ***merely presents a comparison of the attainable bandwidth efficiencies between their proposed MC-CDMA technique and conventional-art DS-CDMA systems using "rake" receivers, as currently practiced in IS-95 cell-phone systems***. This fact is underscored by the following discussion of the concept MC-CDMA in Section II of the Oh paper [pp. 56-562]. The only *mention* of DS-CDMA systems (which are of totally conventional form) is in Section IV of the paper, where the performance comparison between the Oh MC-CDMA signal and standard IS-95 style DS-CDMA is documented. At no point in the Oh paper is any

form of hybrid spread-spectrum system mentioned, much less the pseudorandomly concatenated transmission scheme of the presently claimed invention; thus, Oh clearly does ***not*** anticipate or even suggest the presently claimed invention in any manner, and their MC-CDMA technique is decidedly unrelated to the presently claimed invention. Further, since the MC-CDMA method of Oh fundamentally does not employ any DS spreading at all, the comparison between their paper and the presently claimed invention is inappropriate and erroneous.

Referring to Oh, "[i]n this paper the structure for transmitting the high-speed data at the half bandwidth of the required bandwidth...is proposed."[Oh, Abstract 2nd paragraph.] The bandwidth of a digitally modulated signal of this type is proportional to (and often assumed to be equal to) two times the highest bit rate of the baseband signal. In Oh, this fastest bit rate is called the symbol rate. In our patent, this fastest rate is called the chip rate. Therefore, using the quote above and Fig. 2 of Oh, we see that their proposed system overlaps exactly ½ of the total bandwidth. For comparison purposes, in the example of our patent (see discussion accompanying Fig. 1) which uses 7 chips/bit, the potential overlap is 13/14. This is due to the fact that in our proposed system, we utilize an overlap based on the slower changing (un-spread or un-encoded) data rate, which for this example is 7 times slower than the spread data rate. For more realistic examples in which the spreading ratio is on the order of 100:1, the potential overlap is 199/200 of the bandwidth. Thus, we are approaching full overlap of the hybrid spread-spectrum signals in the frequency domain.

A further note on Oh is the use of the term "symbol" is somewhat confusing, since the use of "symbol" in the context of DS systems usually applies to the spreading ("chipping") waveform (more frequently termed a "chip"). When applied to a multicarrier or OFDM system, "symbol" usually refers to a group or single bit, which represents the modulation on each carrier within the MC or OFDM set. In the standard usage context of DS systems, "chips" represent the spread sequence and "bits" refer to the original (pre-spread) data values. "Chips" occur at many

times (the PN code length) the basic data "bit" rate; e.g., in IS-95 cell-phone systems, the chip rate is 64 times the bit rate.

The Oh reference simply does not meet the presently claimed limitations, and as such, the rejection based on the Oh paper of Claims 1, 7, 10, 27, 28 & 32-24 has been overcome.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 2-3, 6 and 29 stand rejected under 35 USC 103 as obvious over Oh in view of Li Enjia et al. ("The study of FH/MCFD/SSMA/DPSK wireless communications system", International Conference on Communications Technology, ICCT'98, Oct. 22-24, 1998, Pg. S18-06-1 – S18-06-5); (hereinafter Enjia).

The Examiner asserts that Oh has disclosed a method of "Multi-carrier CDMA (MC-CDMA), which is further based on a combination of Direct-Sequence (DS-CDMA) and orthogonal frequency division multiplexing (OFDM) (Introduction, Pg. 561, lines 1-6) as described above." As discussed in detail above, this is simply incorrect. ***Oh does not use DS-CDMA or a hybrid spread-spectrum signaling scheme as in the current case***, but only (Section IV, Pg. 563-565 of the paper) cites a comparison of the performance of their MC-CDMA technique against ***conventional*** DS-CDMA. This DS-CDMA, in turn, does ***not*** employ the advantages of the hybrid (e.g., DS/FH) spread-spectrum techniques of the presently claimed invention.

Regarding Claims 2, 3, & 6, the application of Enjia with Oh to the presently claimed invention is similarly incorrect, since Oh is not using DS techniques but rather OFDM and Enjia is employing OFDM techniques as well, but concatenated with a frequency-hopping scheme that selects a pseudorandom sequence of a *group of OFDM carrier frequencies* which carry a given user's data stream. Thus, Enjia fails to use the frequency hopping in conjunction with either pseudorandom DS and/or TH modulation to achieve higher effective channel capacity, as in the presently claimed invention. The use of differential phase-shift keying by Enjia is totally

conventional and is the norm when a communications channel exhibits essentially random phase. To provide relative ease of synchronization in the receiver, the DPSK format permits a differential carrier phase detection function via successive comparisons of phase on a bit-by-bit basis; the differential encoding/decoding process also deals with +/- phase ambiguities in the RF channel. DPSK is a common-art technique and both Oh and Enjia deal with OFDM approaches (unlike the presently claimed invention, which ***does not need to use OFDM in any form***).

Accordingly, withdrawal of this rejection is respectfully requested.

Claim 4 stands rejected under 35 USC 103 as obvious over Oh in view of Haines (5,469,469) (hereinafter Haines).

Again, Oh simply does not meet the limitations of the base claims. Haines recites a two-channel (in-phase and quadrature – I and Q) spread-spectrum modulator system capable of multiple types of modulation (i.e., code phase, phase-shift keying, amplitude-shift keying, and I/Q differential phase) in fully digital hardware form. Although the system of Haines is useful in the generation of many types of spread-spectrum modulation, he at no time intimates the use of bit-rate orthogonal frequency separation of the transmitted frequencies, nor does any such notion appear in his Specification or Claims. In addition, the hardware of the presently claimed invention is far simpler, cheaper, and lower power than the extremely complex circuitry of Haines. Further, the relationships between the various modulation components in Haines is fixed via the hardware configuration; no means for statistically relating the DS spreading codes and the sequences of output frequencies (e.g., the FH component) are described, nor are any methods of time-hopping control disclosed. Thus, Haines fails to encompass the ability to provide any specific methodology to increase spread-spectrum band user capacity as is taught in this application as originally filed. In addition, claim 4 (continuous-phase frequency hopping) is specifically employed ***in the context of a hybrid spread-spectrum system with minimum (i.e., bit-rate, not chip-rate) frequency channel spacing.*** Indeed, the hardware to provide

digitally controlled continuous-phase frequency/phase/amplitude modulation in a general context was first described in U.S. Patent 4,550,292 to S. F. Smith (one ofthe current inventors).

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 5 and 30-31 stand rejected under 35 USC 103 as obvious over Oh in view of Azad ("Multirate Spread Spectrum Direct Sequence CDMA techniques", IEE Colloquium on Spread Spectrum Technique, 15 April, 1994, Pg. 4/1 –4/5) (hereinafter Azad).

Again, Oh simply does not meet the limitations ofthe base claim. Further, Azad discloses [his page 4/2] a multi-user time-division multiplexed CDMA (TDM/CDMA) technique which transmits the data in small and large predetermined but fxed time slots, according to the respective users' data-rate requirements. However, Azad at no time even hints at a randomized, PN code-controlled time-hopping or slotting methodologyas employed in the presently claimed invention [Figure 4, Example 2, page 17, and Claim 5 of the application]. Therefore, Oh and/or Azad do not disclose or suggest the presently claimed invention. The comment from the Examiner that OFDM is essentially equivalent to FH [last line on page 9 of the response] is demonstrably inaccurate. OFDM is a ***simultaneous*** (parallel) technique, whereas FH implies a ***sequential occupancy*** of a set of frequencies, orthogonal or not.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 8 and 25-26 stand rejected under 35 USC 103 as obvious over Oh in view of Yun (6,243,397) (hereinafter Yun).

Again, Oh does not disclose or suggest the limitations ofthe base claim. Yun discloses an improved methodology for generating a multicarrier parallel combinatoryCDMA (PC-CDMA) system which requires fewer codes than existing-art PC-CDMA systems and can handle data at higher speeds than conventional PC-CDMA systems. The invention of Yun maps groups of input data bits into distinct PN code sets, which in turn modulate a standard arrayof OFDM carriers in the transmitter; the corresponding receiver will demodulate the respective OFDM carriers in

parallel and recombine the individual carriers' output bits into the final composite data stream. The technique of Yun materially differs from that described in claims 8, 25 & 26 because Yun arbitrarily maps PN codes to represent certain input-bit sequences, whereas in claims 8, 25 & 26 the claimed invention takes distinct, contiguous subsets of the master DS n-bit PN sequences to produce the m-bit (shorter) frequency-hopping (FH) control words, which in turn dictate the final RF transmit carrier frequencies via control of a programmable RF synthesizer. Similarly, a subset of the overall DS code may also be used to control the time-hopping component of the transmitted hybrid spread-spectrum signal, as depicted in Figure 4 and specified in claim 5 of this application. Since the use of the subset of bits in the code word in the presently claimed invention has no bearing to the use of PN codes mapped from data-bit groups in Yun, it is maintained that there is no overlap between the techniques and, thus, the rejection is should be withdrawn. Relative to the argument on page 11 of the Examiner's response on Claims 25 & 26 concerning computer and/or DSP implementations, neither Oh nor Yun disclose any DSP or specific computer implementations except to generate the OFDM carrier set; thus, again, since the presently claimed invention does not need to involve OFDM techniques, the limitations of the claims are not met.

Accordingly, withdrawal of this rejection is respectfully requested.

Claim 11 stands rejected under 35 USC 103 as obvious over Oh in view of Natali (5,623,487) (hereinafter Natali).

Again, Oh does not meet the limitations of the base claim. Further, Natali discloses [his column 2, lines 1-5] an orthogonal-code, multicarrier CDMA (OCDMA) technique which employs both orthogonal PN codes (e.g., Walsh-Hadamard types as in IS-95 cell-phone systems) and orthogonally spaced carrier frequencies. This is equivalent to a doubly-orthogonal OFDM CDMA ("DOCDMA) system, where individual users each are assigned separate (orthogonal) spreading codes and separate, individual carrier frequencies. These assignments are conventional (fixed);

at no time does Natali mention the use of pseudorandom frequency assignments, particularly as related to the PN codes, as in the presently claimed invention. Since, again, the presently claimed invention does not need to employ multicarrier or OFDM modulation, there is no overlap between Oh, Natali, and the current invention.

Accordingly, withdrawal of this rejection is respectfully requested.

Other than as explicitly set forth above, this reply does not include acquiescence to statements, assertions, assumptions, conclusions, or any combination thereof in the Office Action. In view of the above, all the claims are considered patentable and allowance of all the claims is respectfully requested. The Examiner is invited to telephone the undersigned (at direct line 512-457-7233) for prompt action in the event any issues remain.

In accordance with 37 CFR 1.136(a) pertaining to patent application processing fees, Applicant requests an extension of time from February 19, 2004 to March 19, 2004 in which to respond to the Office Action dated November 19, 2003. A notification of extension of time is filed herewith.

The Director of the U.S. Patent and Trademark Office is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-0456 of Gray Cary Ware & Freidenrich, LLP.

Respectfully submitted,
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